Thank you, and Good Afternoon.

It is my pleasure today to speak to you about results of the Warfighter Visualization Program.

This program was initiated in the Electronics Technology Office, and has since been moved to the Advanced Technology Office under Tom Meyer.

The program as a whole is now in transition phase, and the results I will show you today should be looked at as a set of technology nuggets that have been matured to the point that they could be incorporated into other programs.

As I go through the presentation, I'd like you to consider how some of the technology could augment or complete projects you are currently doing for the DoD.

Warfighter Visualization is concerned with bringing time critical information to the person who needs it most - the individual warfighter.

The Sniper Window display shown in the graphic illustrates the potential operational utility of providing overlays to the natural scene as viewed by the warfighter.

This individual requires timely updates regarding threats in his immediate environment, yet cannot afford to take his hands off his weapon to check his position and query an information source.

The technical challenges of providing this type of interface are significant, including the need for rugged helmet-mounted displays, six degree of freedom tracking of the individual's gaze in the field, and the construction of a database of geolocated tactical annotations.

The results show scene overlays in which the gaze was tracked using helmet-mounted sensors, and the gaze was stabilized using a small camera.

Solving the human interface problem is an essential step in taking advantage of the great volume of sensor information that will be collected on the battlefield.

The mounted warrior has problems that are significantly different from those of the dismounted warrior.

Tank commanders, for example, may suffer from poor awareness of their immediate environment, particularly in an urban operation when they are buttoned up inside the vehicle.

The See-Through-Turret Visualization System provides 360 degree, day-night vision using eight EO cameras and a single, gimbaled, FLIR.

The video signals from the EO cameras are blended together to form a seamless peripheral visual field, and the FLIR implements a foveal spot, which follows the users gaze and is fused to the daylight background image.

The composite video stream is piped to the commander in the tank through a head-tracked, helmet-mounted display.

This slide shows technology that was adopted by the Air Force and put on the fast track at the onset of Operation Allied Force last spring.

Video from the UAV is processed to create a large mosaic, which is then warped and registered against geolocated background imagery.

By this process, coordinates for targeting can be generated for moving objects on the ground in real time.

Our contractors spent several months in Italy with this system, and it was fully incorporated into operations by the time of the Serbian pullback.

Our experience during this operation showed us that in addition to targeting, Predator ground search operations could benefit from visualization-based tools. We have produced such a tool and are currently working with operators to refine its functionality.

The graphic shows the interface presented to the sensor operator based on a high resolution rendering of the terrain.

Overlaid on the display are MTI radar hits from JSTARS, that are used to cue the sensor operator.

The operator slews a narrow field of view "soda straw" camera to ID potential targets, and georegistratio n is used to produce targeting coordinates.

The Air Force is gaining experience with this system this week and next, as part of the JSEAD and JEFX operational experiments going on at Nellis Air Force Base.

Many of the real time vision processing functions I have described require special purpose processing hardware, making them too expensive for widespread deployment.

To address this, we have produced a special purpose chip that provides this functionality in real time and is used as a plug in board to a PC platform.

Possible applications include stereo recovery from video, real time fusion of EO and IR video, and stabilization.

As an example, consider the Predator video clip shown on the graphic.

A soldier was spotted running down the path to report an explosion in his foxhole.

The motion of the camera makes this clip difficult to interpret.

By mosaicking the video and removing the effects of camera motion, the video is much easier to exploit.

We have investigated the same themes of georegistration and mosaicking in three dimensions, which is more appropriate for military operation in urban environments.

The example shown here will illustrate how a single model of the environment can be built up from multiple streams of both ground and aerial video.

Video was collected at the MOUT facility in Quantico, Virginia.

A UAV helicopter was flown between the buildings and used to acquire aerial video from an altitude that was close to the height of the rooftops, emphasizing the three- dimensional nature of the environment.

The ground level video was taken using a handheld camera.

Notice the person running down the road and through the scene on the right.

We will see him again later.

The next slide shows how the model is built up from raw video sources such as these.

Whereas in two dimensions we made use of pre-existing georegistered ground imagery, in three dimensions we will take advantage of a pre-existing facet model for the buildings.

Using this model, the video stream can be thought of as a flashlight that is used to illuminate the model.

In this way, video pixels from many sources can be used to paint the models with color and texture.

The model can now be re-rendered from any viewpoint.

This could be useful for military functions such as mission planning and rehearsal.

Finally, we can extract the runner from the raw video as a moving object and render the model view from his perspective as he runs along.

The results suggest that many streams of low-quality tactical video can be used effectively in building up a single high quality model.

Finally, the registration and mosaicking technologies are being adapted as a dual use application for medical imaging.

The bottom images show a lesion detected in a patient's chest cavity using two - disparate - sensor modalities.

By viewing these images as a single registered and fused three-D data set, the clinician was able to better understand the exact location of the tumor.

In this example the image changed the course of treatment, and the patient is now in remission.

As you browse the DARPA web site for this program you will find other examples of technologies that are ready to be incorporated in programs through partnership and licensing agreements.

Please feel free to contact me for any follow up discussions.

Thank you for your attention.